

# Perception of Voice in the Transgender Client

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**Summary.** Fundamental frequency ( $F_0$ ) of speech is used to measure the success of voice therapy in male-to-female transgender clients. This study evaluates the relationship between  $F_0$  and patients' happiness with their voice. The study design used was a cross-sectional evaluation of client satisfaction questionnaires and voice recordings from transgender clients. This study was a comparative evaluation of voice recordings by voice professionals and lay observers. Twelve male-to-female transgender participants completed visual analogue scales (VASs), rating happiness with self-perceived femininity of their voice. Fifteen speech and language therapists (SLTs) and 40 naïve observers evaluated the anonymized recordings, using the same rating system. The correlation between mean  $F_0$  and participant happiness was established. Relationships between participant happiness and rater opinions were explored. A significant relationship between  $F_0$  and participant happiness could not be demonstrated ( $r = 0.32$ ,  $P = 0.32$ ). There was a moderately strong positive correlation between self-perception of vocal femininity and perception of femininity by SLTs and naïve observers ( $r = 0.76$  and  $0.68$ ,  $P = 0.003$  and  $P = 0.01$ , respectively). This study demonstrates that happiness with voice in male-to-female transgender clients is not directly related to  $F_0$ . Clients can assess femininity of their voice in the form of perceived pitch. This may not affect happiness scores. Voice satisfaction may not correlate with perceptions of supervising voice professionals. However, professionals can reliably evaluate how the voice will be received by the lay public. Subjective measures of patient satisfaction, including VASs, are reliable and valid tools in evaluating therapeutic success.

**Key Words:** Transsexualism—Voice—Voice quality—Voice disorders.

## INTRODUCTION

Transsexualism is a complex condition involving a paradoxical feeling of belonging to the opposite sex. Prevalence in the United Kingdom is estimated at eight per 100,000,<sup>1</sup> and over 75% of cases are males wishing to be recognized as females.<sup>2</sup> Acquiring a sex-appropriate voice is a fundamental part of the patient gaining acceptance in their new gender. Androgen therapy in female-to-male transsexuals increases the bulk of the vocal cords. Consequently, such clients achieve the desired voice with relative ease, and rarely come to the attention of voice professionals. As estrogen supplementation has no effect on the biologically male larynx, the same does not apply to male-to-female transsexuals.<sup>3</sup>

Speech and language therapists (SLTs) and otolaryngologists play an important role in influencing communication behavior in transgender patients. Treatment is aimed toward developing a healthy voice within the frequency ranges for the appropriate sex, along with the development of appropriate paralinguistic behaviors. Specialist voice training and laryngeal surgery aim to alter the fundamental frequency ( $F_0$ ) of speech to one acceptable for the patient's sex. Various surgical techniques can be used to increase  $F_0$  surgically. These involve either reducing the bulk, shortening, or increasing tension of the vocal cords. Cricothyroid approximation is a popular technique, increasing

cord tension with a resulting increase in  $F_0$ . An  $F_0$  of 165 Hz represents the borderline frequency above which a voice is perceived as female.<sup>4</sup> The literature focuses on male-to-female clients, with a postintervention increase in  $F_0$  taken as evidence of therapeutic success. Because of the select nature of this population, studies are often retrospective, with limitations regarding participant numbers and completeness of data.

Soderpalm et al retrospectively analyzed 25 consecutive transsexual individuals undergoing voice therapy and/or phonosurgery.<sup>5</sup> The subjects were at varying stages of gender reassignment. Only 12 patients had vocal findings documented at initial assessment and follow-up. The 10 patients receiving speech therapy demonstrated an improvement in  $F_0$  of  $>20$  Hz ( $P < 0.01$ ). A lengthier period of therapy ( $>14$  sessions) was associated with a satisfactory  $F_0$  of  $>165$  Hz. Both patients undergoing cricothyroid approximation achieved an increase in  $F_0$  to  $>165$  Hz. Voice intervention was therefore deemed successful. Clients were asked to rate the femininity of their voice on a scale of 1 to 10 before and after therapy. However, only five clients completed both scores and no significant subjective improvement could be demonstrated.

Interactions between physical appearance and voice in transgender patients were explored by Van Borsel et al.<sup>6</sup> They hypothesized that if the voice of a transsexual could betray biological gender, femininity would be judged higher in a visual-only presentation. Fourteen male-to-female transsexuals were evaluated in "visual-only," "auditory-only," and "audio-visual" presentations. Femininity of voice was graded on a visual analogue scale (VAS) by 22 laypersons and 22 speech therapists, blinded to the participants' history. A positive correlation of 0.535 ( $P = 0.049$ ) was found between speech frequency and perception of the voice as female. Most participants scored higher in the visual format. A poor visual score tended to be corrected by a high voice score. If visual

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appearance and speech frequency interact in the perception of femininity, a less-than-acceptable physical appearance could be compensated for by attention to voice quality, and *vice versa*.

Yang et al reported a series of 20 patients undergoing cricothyroid approximation.<sup>7</sup> Fifty percent of subjects felt their voice now fitted with their self-perception, with 20% feeling neutral about their new voice, and the remaining 29% responding negatively. However, subjective responses did not correlate with objective measurements. The results are also difficult to interpret as the pitch changes are described in semitones. It was noted that subjects who received speech therapy achieved a lower  $F_0$ , with a reduced pitch range, although this was thought to be due to selection bias. Fourteen male-to-female transsexuals who underwent cricothyropexy  $\pm$  anterior commisure advancement were described by Wagner et al in 2003.<sup>8</sup> Voice parameters were assessed using electroglottography and speech therapy evaluation. Eleven patients experienced an improvement in  $F_0$  (range, 9–114 Hz) and 11 patients expressed satisfaction with the results. Again, the measured improvement in  $F_0$  did not always correspond with patient satisfaction.

$F_0$  is frequently used in the objective, instrumental evaluation of voice. Examples of its use include a diverse range of conditions from management of vocal cord palsy to effects on voice after treatment of Parkinson's disease and multiple sclerosis.<sup>9–11</sup> However, the quality and perception of  $F_0$ , that is, pitch, is not used in the judgment of dysphonia, either by voice professionals or the clients themselves. Perceptual evaluation of voice is an integrated process of listening to and describing a voice. Voice professionals develop skills of perceptual evaluation, both informally and *via* the use of validated protocols, such as GRBAS (a perceptual scale accessing the grade, roughness, breathiness, asthenia, and strain of a clients voice).<sup>12</sup> There is work showing that inter- and intrarater reliability between voice professionals is only moderate, and that trained raters may not evaluate voice more reliably than novices.<sup>13,14</sup> Naïve listeners judge voice based on normal voices, rather than the complex "auditory templates" of professionals, and it is suggested that the opinion of the naïve observer is, therefore, valid. Lee et al evaluated the reliability and validity of dysphonic patients rating their own voice quality.<sup>15</sup> They found that patients have reliable and valid perception of voice, when using validated scoring systems. Naïve listeners also perceive the normal voice reliably. However, patient-clinician inter-rater reliability was no better than chance, suggesting the treating voice therapist's opinion may not reflect how the client's voice is received by the general public. Patients judge therapeutic success by perceived improvement and because patients seek treatment because of a perceived abnormality, their opinion on outcome is essential.<sup>13,16</sup>

Subjective criteria may provide a more useful measure of success than objective measures in gender reassignment surgery (GRS).<sup>17</sup> To date, there is little information regarding the subjective success of voice therapy and/or surgery in transgender patients. The lack of standardized subjective markers makes such information difficult to interpret. There is a paucity

of literature on either the voice therapist's or naïve listener's evaluation of the transgender voice. Voice therapists play an important role in the therapeutic and pastoral care of this specialist client group. The opinion of such clinicians, who are involved with the progress of transgender clients throughout their transition, should be valued. Transgender individuals are also judged by their voice on a day-to-day basis by members of the public with no experience of voice analysis. This has a significant effect on their integration into their new role. In Van Borsel et al's study, ratings of transgender voices were comparable between speech pathologists and naïve observers.<sup>6</sup>

An increase of  $F_0$  into the female range is perceived as a successful outcome in transgender voice therapy. It is important that the voice of the transgender patient is appropriate to their gender and achieving an acceptable  $F_0$  is undoubtedly desirable. However, there is little evidence to suggest that this is perceived as success, either by the clients or their treating clinicians.  $F_0$  may not be a good indicator of how the transgender voice is received by the general population.

This study aims to assess the relationship between  $F_0$  and satisfaction with voice in male-to-female transgender clients. The perception of femininity of voice is explored from both the patients' viewpoint and that of professional and lay observers. The relationship between satisfaction with voice, the client's opinion on the femininity of their voice, and  $F_0$  will be determined. The relationship between satisfaction with voice and quality of life is evaluated.

## METHODS

### Ethical approval

Approval from the Multi-Centre Research Ethics Committee (Scotland B) was obtained before commencement of the study.

### Study design

This was a cross-sectional study of transgender clients in the North-East of England and North Cumbria, United Kingdom.

### Participants

Potential study participants were recruited *via* the Specialist SLTs and the Sexual Health Services at the Royal Victoria Infirmary, Newcastle-upon-Tyne and James Cook University Hospital, Middlesbrough, United Kingdom. Fourteen of 20 clients responded to the written request to participate in the study.

Clients with other gender identity disorders were excluded from the study, for example, intersexuality. This distinction was made as these individuals have abnormal karyotypes, resulting in physiological and hormonal changes, rather than a true gender dysphoria. Two participants with Klinefelter syndrome were, therefore, excluded from the study. No female-to-male transgender clients were known to voice therapy services at the time of this study.

Participants completed a questionnaire, establishing general demographic data, voice therapy received, and satisfaction with voice. Issues relating to transgender voice were explored, including situations where voice use was problematic. All

participants gave written consent and were reassured of confidentiality and anonymity. They were informed that the aim of the research was to provide information and offer guidance to prospective transgender individuals and their clinicians.

The participants were asked to make a recording of the Rainbow Passage in their usual speaking voice.<sup>18</sup> Recordings were carried out using an Olympus WS-100 digital voice recorder and microphone headset (high-quality [HQ] mode—frequency response 100–12,000 Hz, sampling frequency 44.0 Hz, Olympus Imaging America Inc., Pasadena, USA). Recordings took place in a quiet room, with the microphone placed 5 cm away from the mouth. As initiation of speech may allow the overall impression of voice to be established, the first paragraph of the passage was used to calculate  $F_0$ . Digital recordings were converted to .WAV format (*Wavepad Masters Edition Audio Editing* software, NCH Swift Sound, Canberra, Australia) and mean  $F_0$  calculated using *Praat phonetic analysis* software.<sup>19</sup>

The participants completed two VASs evaluating the subjective impression of their voice. Each participant marked how feminine they felt their voice was on a scale of 0 (very masculine) to 10 (very feminine). The second scale assessed how happy they were with their voice (0—very unhappy, 10—very happy). Participants were asked to evaluate their voice based on their own perceptions, rather than from a recording. As participants were at varying stages of voice therapy, they were asked to concentrate on their feelings about their voice at that point in time. The participants also completed the voice handicap index (VHI) and the Glasgow Benefit Inventory (GBI) as indices of quality of life.<sup>20,21</sup>

Recordings of 12 male and 13 female control participants were performed in identical conditions to the transgender participants, and mean  $F_0$  documented. The control participants had no history of voice pathology or gender dysphoria. All 37 recordings were randomized and compiled onto an audio compact disc.

Fifteen SLTs and 40 naïve observers were recruited to evaluate the recordings. They were asked to listen to each voice individually and complete the femininity VAS, according to their perception of the recorded voice. All were blinded to the identity and medical history of the participants. The naïve observers had no experience of voice analysis.

### Statistical analysis

Data were imported into *SPSS (Statistical Package for Social Science, Chicago, IL)* version 12.0 for analysis. The data for  $F_0$ , participant, and observer voice ratings were normally distributed. Inter-rater reliability was calculated using the intra-class correlation coefficient. The relationships between  $F_0$ , participants' perception of voice, and rater femininity scores were assessed using Pearson's correlation coefficient. GBI and VHI scores were calculated and their relationships to participant happiness established.

## RESULTS

### Patient demographics

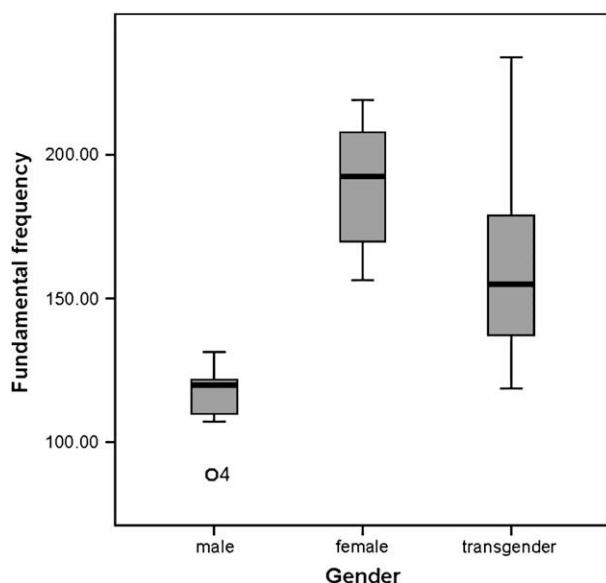
Twelve male-to-female transgender participants completed the study. The participants were aged from 32 to 65 years old (mean, 47.5). Age at recognition of gender dysphoria ranged from 3 to 13 years (mean, 6.5) with a mean age at initiation of therapy of 36 years (range, 7–53). All participants were receiving estrogen supplementation and living in the female gender role. All participants had received voice therapy, the length of which ranged from two sessions to 30 months (mean, 12 months) (Table 1). Two participants underwent a cricothyroid approximation in addition to voice therapy.

Eleven participants described situations where they felt their voice let them down. The most common instance was using the telephone (9/11), followed by coughing (5/11), and laughing (4/11). Other instances included speaking at volume, singing, when stressed, and when talking in a foreign language.

**TABLE 1.**  
**Demographic Data of Study Participants**

Client	Age	Age at Realization of Transsexualism	Age When Help Sought	Length of Speech Therapy (Months)	Phonosurgery	$F_0^*$	Self-Perceived Femininity of Voice*	Happiness With Voice*	Mean SLT Score*	Mean Naïve Observer Score*
1	41	7	40	3	No	141	2.9	1.9	3.4	5.0
2	51	3	48	13	No	147	5.3	6.9	4.9	5.6
3	36	4	24	24	No	163	6.1	7.5	6.1	5.9
4	55	13	50	24	No	233	6.4	6.6	5.0	6.2
5	65	5	40	3	No	160	5.0	0.0	2.6	3.4
6	55	5	46	5	No	194	8.0	8.2	7.8	7.8
7	32	7	26	6	No	150	6.4	3.7	6.0	6.5
8	48	4	42	14	Yes	179	2.2	2.2	4.9	5.6
9	56	8	53	10	No	121	3.1	7.6	1.3	2.6
10	42	9	17	30	No	118	1.8	1.9	3.5	4.7
11	41	7	7	12	No	134	3.8	4.5	3.9	4.5
12	49	5	39	24	Yes	178	5.8	10	6.6	6.8

\* Indicates score from VAS—score out of 10.



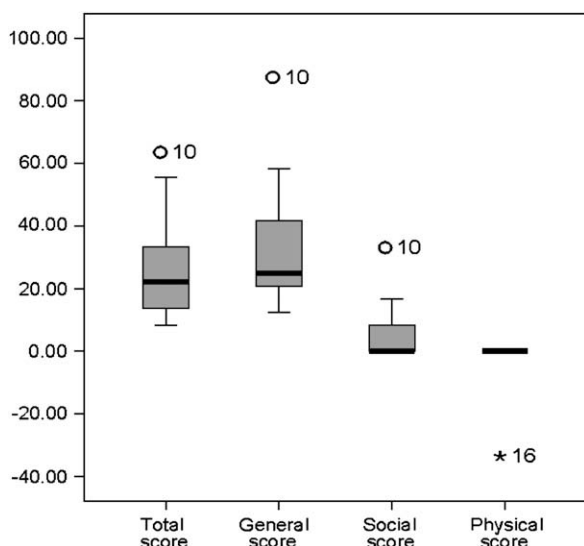
**FIGURE 1.** Box plot demonstrating distribution of  $F_0$  of speech, according to gender. Median, total, and interquartile ranges are shown, with one extreme outlier within the male control group highlighted.

### Voice analysis

Mean  $F_0$  for all 37 voices ranged from 89 to 233 Hz (mean, 155 Hz) (Figure 1). The frequency distribution in transgender participants ranged from 118 to 233 Hz (standard deviation [SD], 32.9 Hz)—the mean of 159 Hz being the borderline frequency at which voices are perceived as female.<sup>4</sup> This compares with the male distribution of 89–131 Hz (mean, 116 Hz; SD, 10.9 Hz). Frequency distribution of the female controls was 156–218 Hz (mean, 187 Hz; SD, 20.8 Hz), lower than the literature describes (mean, 217 Hz; range, 165–255 Hz).<sup>3,22</sup>

### Quality-of-life assessment

Eleven participants completed the GBI. All had an improved quality of life after voice intervention (Figure 2). Total scores



**FIGURE 2.** GBI scores after voice therapy in male-to-female transgender participants.

ranged from 8.3 to 63.8 (mean, 27.3; SD, 18.2). Highest scores were found in the general subgroup, ranging from 12.5 to 87.5 (mean, 34.1; SD, 22.7). Social scores ranged from no change to a positive effect of 33.3 (mean, 6.1; SD, 11.2). Physical well-being was unchanged in 10 participants. One participant developed a hematoma after cricothyroid approximation. She has persistent problems with vocal fatigue and throat discomfort, resulting in a negative physical score.

### Voice handicap index

All participants completed the VHI (Figure 3). A higher score indicates a greater level of handicap. Total scores ranged from 1 to 71 (mean, 26.3; SD, 19.3), functional scores from 1 to 14 (mean, 6.3; SD, 4.0), and physical scores from 0 to 30 (mean, 11.6; SD, 8.7). Emotional scores ranged from 0 to 29 (mean, 8.4; SD, 8.3). The mean scores of the participants fall within the range of mild vocal dysfunction.<sup>20</sup> The client with the outlying VHI scores had recently commenced her voice therapy.

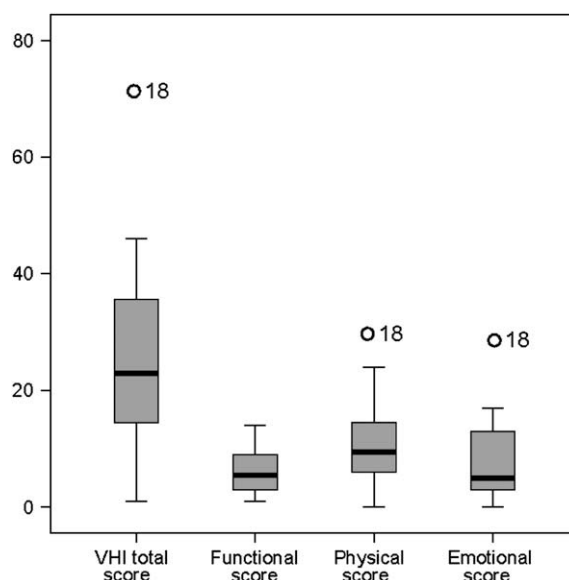
### STATISTICAL ANALYSIS

#### Reliability and validity

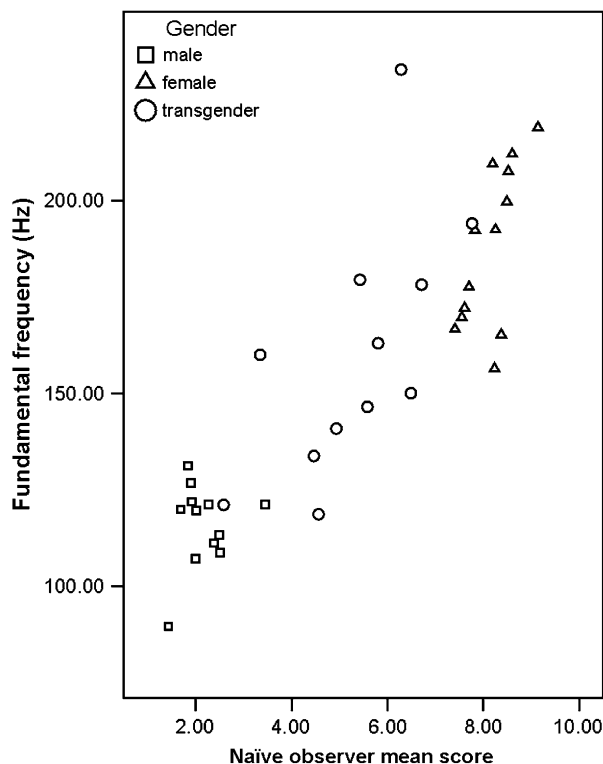
The intraclass correlation coefficient was  $r = 0.88$  between the speech therapists over all 37 voices. The agreement between naïve observers was also high at  $r = 0.80$ . The mean scores for each group were used to assess further relationships. The agreement between SLTs and naïve observers was  $r = 0.99$ . When evaluating the transgender voices only, the SLT interrater reliability was 0.69 compared with 0.48 in naïve observers. The agreement between the SLTs and naïve observers' mean scores was  $r = 0.97$ .

#### Perception of femininity

When all voices were evaluated, there was a high correlation between the perception of femininity and  $F_0$ , by both SLT and



**FIGURE 3.** VHI scores after voice therapy in male-to-female transgender participants.



**FIGURE 4.** Scatter plot showing relationship between naïve observer femininity scores and  $F_0$ .

naïve observers ( $r = 0.86$  and  $0.87$ , respectively;  $P < 0.01$ ) (Figure 4). However, when transgender voices were evaluated, the correlation was  $0.64$  for both observer groups ( $P = 0.03$ ). There was an excellent correlation between SLT and naïve observer opinions on the femininity of the transgender participants' voices ( $r = 0.98$ ,  $P < 10^{-6}$ ).

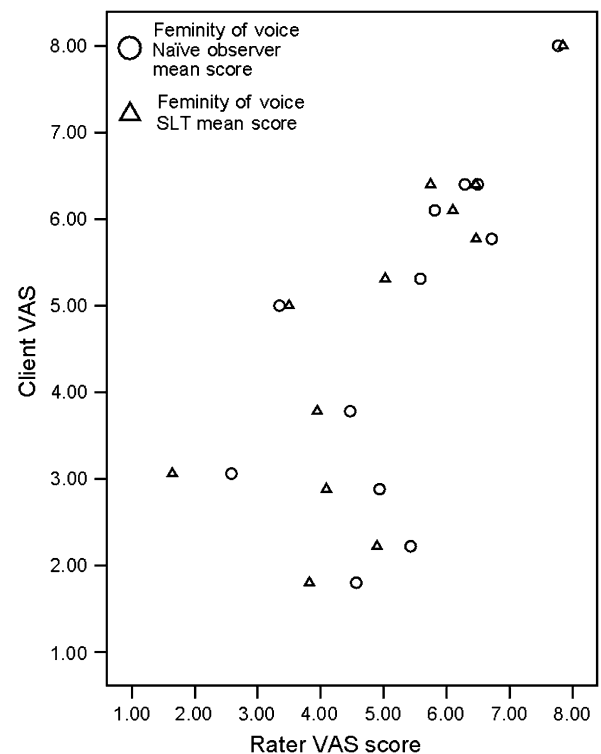
There is a moderately strong relationship between how feminine the clients' feel their voices are and how feminine they are perceived by both SLTs ( $r = 0.76$ ,  $P = 0.003$ ) and naïve observers ( $r = 0.68$ ,  $P = 0.01$ ) (Figure 5). The correlation between client perception of femininity of their voice and  $F_0$  was  $r = 0.61$  ( $P = 0.03$ ).

A low self-perceived femininity correlated with lower GBI scores (total  $r = 0.70$ , general  $r = 0.66$ ) and higher emotional VHI scores ( $r = 0.59$ ).

### Happiness with voice

When transgender participants' evaluated how happy they were with their voice, the pattern changed. It was not possible to demonstrate a statistically significant relationship between patient happiness and  $F_0$  ( $r = 0.32$ ,  $P = 0.32$ ) (Figure 6). The square of the correlation coefficient was calculated ( $r^2 = 0.1$ ), suggesting that only 10% of the overall variance in patient happiness can be explained by changes in  $F_0$ .

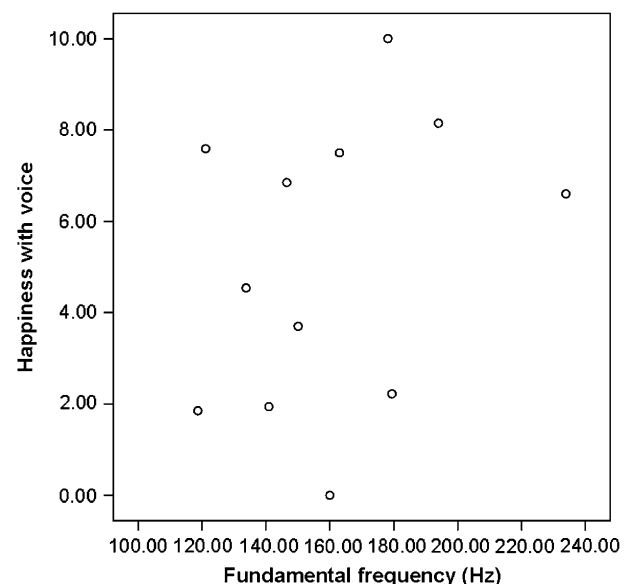
Self-perception of voice femininity tended to be related to happiness with voice ( $r = 0.55$ ,  $P = 0.06$ ). A relationship between observer perception of femininity and participant happiness with voice was also less easy to establish (SLT  $r = 0.46$ ,  $P = 0.17$ ; naïve observer  $r = 0.45$ ,  $P = 0.14$ ). Examples are found in the participant with an  $F_0$  of 121 Hz and observer



**FIGURE 5.** Scatter plot showing correlation between self-perception of femininity of voice and observer opinion.

evaluation of 1.6/10 but a voice happiness score of 7.6/10. Conversely, a participant with an  $F_0$  of 234 Hz and a voice happiness score of 6.7/10 was given a femininity rating of 5.7/10.

There was a positive correlation between total and general GBI scores with participant happiness with voice ( $r = 0.67$  and  $r = 0.63$ , respectively [ $P = 0.02$ ]). There was a negative correlation between total and emotional VHI and happiness with voice ( $r = 0.59$  and  $0.67$ , respectively). There was no demonstrable relationship between length of speech therapy



**FIGURE 6.** Scatter plot demonstrating relationship between transgender participant happiness with voice and  $F_0$ .

received and happiness with voice ( $r = 0.31$ ,  $P = 0.33$ ) or self-perceived femininity ( $r = -0.12$ ,  $P = 0.72$ ).

## DISCUSSION

After an extensive search of the literature, this is the only research evaluating the satisfaction of transgender clients after voice intervention. The literature describes increased  $F_0$  after voice therapy and/or surgery as success. Although this may certainly be a technical success, there is little evidence describing whether this is perceived as a success by the client themselves. This study assesses the relationship between  $F_0$  of speech and patient satisfaction after transgender voice therapy/surgery. The results suggest that patient happiness with their voice is not directly related to  $F_0$ . It, therefore, may not be advisable to assume that a higher postintervention  $F_0$  is reflected by satisfaction in the eyes of the client. Clients can, however, assess the femininity of their voice accurately, in the form of perceived pitch. This suggests that although clients may have a good idea of how their voice comes across to others, this does not necessarily correspond with patient satisfaction. Subjective measures of patient satisfaction are likely to be a more valuable evaluation of therapeutic success.

Similarly, the client's happiness with their voice may not correlate with perceptions of their supervising voice professional or the lay public. The relationship between  $F_0$  and perception of femininity is not as clear-cut in the transgender voice compared with controls. Both observer groups are good at recognizing the extremes of frequency and the associated gender, but agree less on the transgender voices (Figure 4). However, given the correlation between SLT and naïve observer opinions, the voice professional will have a good idea of how the client's voice will be received by the lay public. Quality of life was universally improved after voice intervention, and most clients have a mild voice handicap when assessed using the VHI. There is strong agreement between the femininity ratings of SLT and naïve observers, both within and between observer groups. The correlations between participant and observer femininity ratings suggest that a VAS is a reliable and valid means of assessing perception of voice in transgender patients. This has obvious benefits in that it is simple to complete, easily understood, and repeatable. Patient happiness scores also correlated significantly with GBI scores. Greater VHI scores were significantly related to lower patient happiness scores. This again highlights the role of the VAS and demonstrates how it can work in parallel with established measures of both voice quality and quality of life.

The findings of this study have implications regarding the definition of success in transgender voice therapy. Objective measures have a valuable role in evaluating therapeutic success, particularly if preintervention measurements are available for comparison. It may be encouraging for the client when a significant part of their progress can be quantified, and frequency changes could form part of a biofeedback program. Study participants with a higher  $F_0$  were perceived as more feminine by both SLTs and naïve listeners. However, these findings suggest that there is more to the transgender client's perception of a successful voice than  $F_0$  alone.

There are a number of gender differences in voice, beyond  $F_0$ . Gunzburger noted that transgender clients spoke with a higher pitch and greater pitch range, when using their female voice. Change in formant patterns also influence judgments of gender.<sup>23,24</sup> Women display a greater variety of intonational patterns and the female voice is more breathy than the male.<sup>25</sup> Oates and Dacakis comment that interactions between mean  $F_0$ , frequency range, patterns of intonation, and resonance determine the perception of the speaker as female.<sup>26</sup> These features may have impacted on the interpretation of the voices in this study. Differences in vocabulary can also discriminate between genders. Women tend to use more words implying feeling and emotion, more evaluative adjectives, for example, "marvelous," and more qualifying statements, for example, "perhaps."<sup>27,28</sup> Deliberate manipulation of these acoustic and perceptual features may allow a low-pitched voice to be perceived as more feminine.

The client's personality may have an effect on the perception of success. From the author's subjective viewpoint, some participants had a more positive outlook regarding their transition to the female role. These clients were more confident and less concerned about how other people perceived them. Others were aware of the limitations of their vocal pitch, and compensated using other aspects of speech and attention to their physical appearance.

## Strengths and weaknesses

This is an original study in a select subject group. It highlights the fact that an increased  $F_0$  may not reflect success in transgender voice therapy. However, the lack of a demonstrable significant relationship between  $F_0$  and happiness with voice may be due to a small sample size. Forty participants would be required to demonstrate a significant relationship. The hospitals and specialist voice therapists involved in this study cover a population of approximately 1.2 million men aged 15 years and older (data from 2001 UK census). Assuming a prevalence of transsexualism of eight per 100,000 and a 3:1 ratio of male-to-female clients, this suggests there are around 60 potential clients within this region. Twenty clients were known to the two specialist SLTs covering this area, 12 of whom responded to the invitation to take part in the study. There are a number of reasons why the number of participants is low. All the potential clients within the area have not made the transition to their new gender role, and have not come to the attention of the Gender Reassignment Services. Some clients may be happy with their voice and not feel the need for voice therapy. A major factor limiting client numbers is the fact that the clients in our study received voice therapy under the auspices of the National Health Service. Limited funding means that the throughput of clients undergoing gender reassignment is very restricted. There may be other clients who have funded voice therapy privately, and have not come to the attention of our voice therapy services.

Given these difficulties, it would be very difficult to follow clients through voice therapy from start to finish. To maximize the data available, a cross-sectional study design was used. Clients were asked to focus on their feelings about their voice at that point in time, and the voice recordings and observer

opinions documented at the same point in their therapy. However, despite limited numbers, we feel that our study has provided information that would be useful to other voice professionals.

Achieving an acceptable voice in transgender clients takes a considerable amount of time. As this study concentrates on the perception of voice at a static point in time, it would be valuable to assess clients at the beginning of therapy to evaluate differences between pre- and postintervention measurements. The baseline  $F_0$  needs to be considered, as a 30 Hz increase in  $F_0$  from a baseline of 100 Hz may be considered as a significant success by a client, despite still being in the male range. The same increase may not be perceived as success by a client with a baseline  $F_0$  of 140 Hz, for example.

### Future research

Recruitment of transgender clients is continuing, to enhance the statistical power of further studies. Analysis of voice satisfaction in female-to-male transgender clients would also be valuable.

Outcome predictors for the success of GRS have been suggested. Increased patient satisfaction is reported in patients younger than 30 years at treatment initiation and in those with gender nonconformity in childhood.<sup>29</sup> Conversely, dissatisfaction is reported in older age, late onset of desire for GRS, previous marriage, and biological parenthood.<sup>17,30</sup> Identifying patients who may respond less well to voice intervention would allow refining of techniques and realistic expectations of achievable outcomes. Further analysis of personality characteristics and demographic factors may also be valuable.

### CONCLUSION

This study demonstrates that the male-to-female transgender clients' happiness with their voice is not directly related to  $F_0$ . Other aspects of voice may be more important in establishing an acceptable voice. Clients have a good idea of how their voice comes across to others, but this does not necessarily correspond with happiness scores. Subjective measures of patient satisfaction are a more valuable evaluation of therapeutic success. VASs are reliable and valid tools in assessing subjective success.

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